INSTRUCTION MANUAL

LH-42D

S/N 613

SPECTRUM Analog electronic filters

SECTION I

General Information

1-1. DESCRIPTION

1-2. Spectrum Instruments Type LH-42 ANALOG Filter* is a continuously tunable active network operable at will as either a high-pass or direct-coupled low-pass frequency selective device. As in all ANALOG Filters* the transfer characteristic of a prototype passive network is synthesized by circuit configurations employing only resistance, capacitance and active elements. Use of inductors, with their frequency limitations and other attendant problems, is consequently avoided. The LH-42 is based upon the 7-pole Butterworth prototype.**

1-3. Two Type LH-42 unit filters, packaged together with one Type PS-12 solid state power supply, comprise the Type LH-42D ANALOG Filter Set, which provides the convenience of a multi-function filter in an integral, rack mounting format. Type LH-42D equipment is manufactured in a number of tuning frequency ranges, each designated by an identifying style letter. All style variations are identical in appearance and physical dimensions and are basically rack mounting, with the option of an external cabinet for table use available at extra cost. The several tuning ranges, or styles, are identified as follows:

STYLE A	20 - 200,000 cps	STYLE E	0.2 - 20,000 cps
STYLE B	2 - 20,000 cps	STYLE F	0.2 - 200,000 cps
STYLE C	0.2 - 2,000 cps	STYLE G	0.02 - 2,000 cps
STYLE D	2 - 200,000 cps	STYLE H	0.02 - 20,000 cps

1-4. The Type LH-42D Filter Set is normally supplied with panel terminals of the Millen variety and spacing, which will accept standard banana-plug connectors of the shielded or unshielded variety, or, optionally, wire, pin-plugs or spade lead terminations. The individual unit filters of the set are provided with terminal posts which are independent except for the common low side. The unit filters may be used in separate signal channels, with this restriction, or used in combination for several modes of operation in a single channel, including band-pass, band-reject, or double-rate-of cutoff high-pass/low-pass. Channel input terminations are single-ended and bridging (high-impedance). Channel output presents relatively low internal impedance combined with large signal-handling capability. Filtering characteristics are isolated from interaction effects by buffering active elements and matching of impedances to externally connected lines or devices is normally a matter of connecting suitable resistors to the terminals as required by circumstances.

1-5. Type LH-42D Filter Sets require a source of 105-125 volt, 50-60 cycle a-c power for operation. Internal regulators make operating characteristics virtually independent of line disturbances.

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***For a discussion of filters based upon the Butterworth function, see Guillemin, "Synthesis of Passive Networks", Wiley, 1957.*

SECTION II

Installation

2-1. Unpack the instrument carefully upon receipt and inspect for any indications of shipping damage. Record pertinent details of any such damage together with instrument identification data and file a report of same at once with the carrier. Forward a copy of any such report to the manufacturer.

2-2. Rack mounting instruments are ready for use as received. When mounting it is suggested that non-marring washers be used to protect the panel surface.

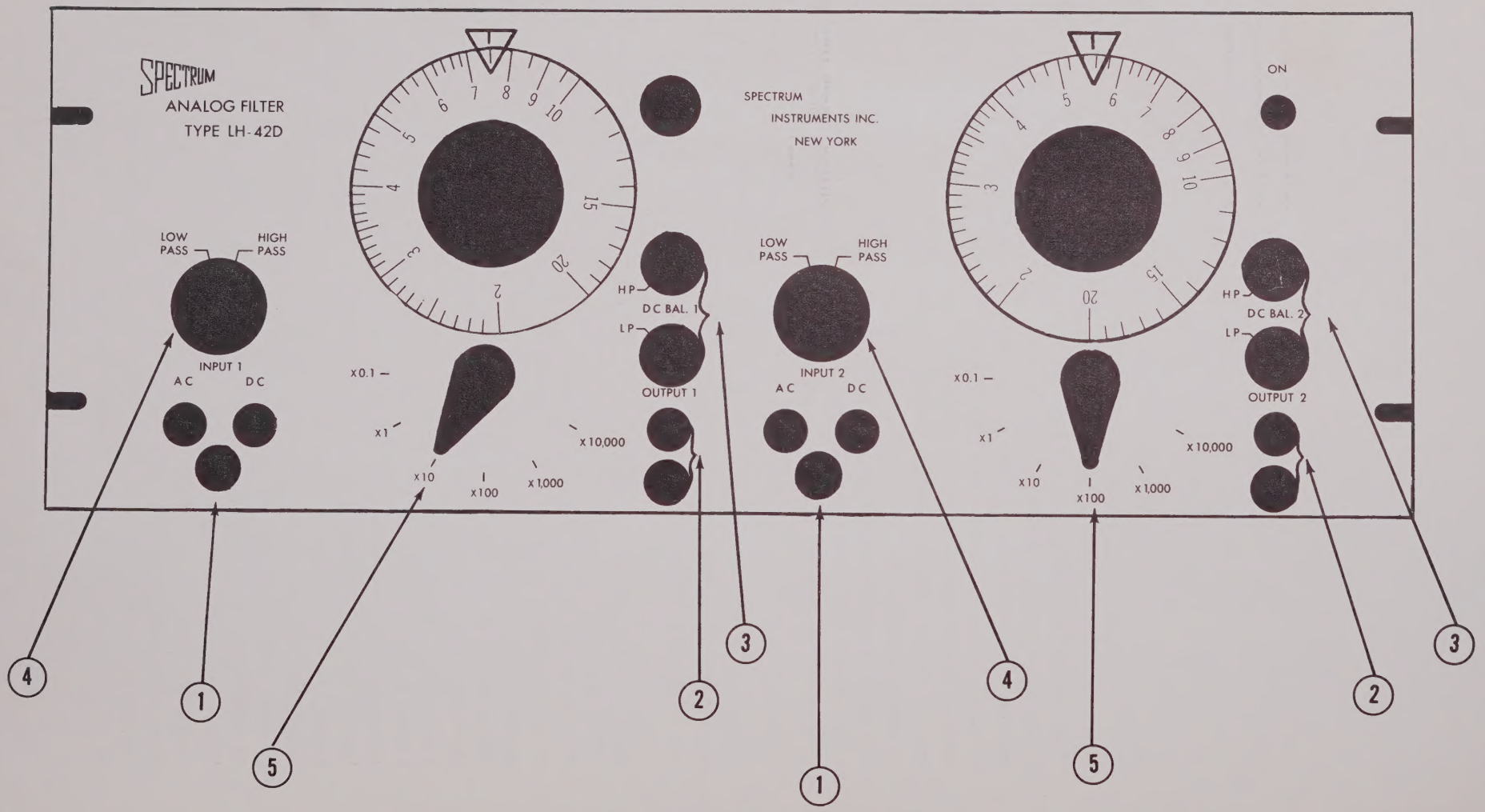
2-3. Environmental precautions should be observed. Ventilation openings should be checked for free circulation of air through the equipment as mounted. Note should be taken of companion equipment characteristics to insure against accidental overheating from an outside source. When in doubt, suitable internal temperature checks should be made with the set-up in operation and temperature stabilized. In no event should this equipment be operated in an ambient in excess of 50°C. (122°F.)

2-4. Instruments supplied with cabinets may be shipped either with cabinets installed or as two packages for assembly at destination. Carrier's package weight limitations or other considerations may make the latter course advisable. Installation in the cabinet is a simple matter of aligning the panel notches with the cabinet screw holes and securing, paying due attention to avoid pinching of the line cord in the process. Ventilation considerations are similar to those for rack installations, except for the problem of adjacent heat producing equipment.

2-4. To operate, the equipment must be connected to a source of 105-125 volt, 50-60 cycle a-c power. Where power source stability is poor or it is desired to secure absolute minimal drift of the d-c output offset, interposition of a harmonic compensating Sola or like regulating transformer may be desirable. Such a regulating transformer should be placed as far away from the instrumentation as possible to preclude pick-up due to the stray magnetic fields typically associated with such devices.

2-4. Our instruments are usually shipped in specially fitted and cushioned containers designed for maximum protection of the specific item. It is suggested that our original packaging be stored for re-use in the event that a return must be made to the factory for any reason. In any event, an instrument to be reshipped should first be covered with paper or other soft material to prevent scratching, then located in a secure fiber or wood container surrounded with several inches of rubberized hair, urethane foam or other suitable shock absorbing material. Strapping, or sealing of the package with reinforced tape is desirable. Mark package exterior prominently: "Delicate Instrument - Fragile". NOTE: If the instrument is to be returned to the factory for service or repair first notify in writing, giving a complete identification and all information available concerning the difficulty to be corrected.

Front Panel


SPECTRUM
ANALOG FILTER
TYPE LH-42D
SPECTRUM
INSTRUMENTS INC.
NEW YORK
ON
LOW PASS
HIGH PASS
INPUT 1
AC
DC
HP
DC BAL. 1
LP
OUTPUT 1
INPUT 2
DC BAL. 2
OUTPUT 2
x0.1
x1
x10
x100
x1,000
x10,000
1
2
3
4
5

SECTION III

Operating Instructions

3-1. This instrument is ready for use as delivered from the factory. Following removal from shipping container, inspection and installation the user should familiarize himself with the remainder of this section before attempting operation.

3-2. All operating controls and terminals are located on the front panel of the instrument. In LH-42D Filter Sets the individual unit filters are identified by numerals "1" and "2" associated with their respective input and output terminals. Unit #1 at the left and unit #2 at the right of the panel are identical in all respects and the physical layout of their controls and terminals is the same. Except for the common connection of all low-side terminals the filter units may be used independently of one another in separate signal channels.

3-3. The following description of panel controls and terminal arrangement applies equally to left or right filter sections;

(1) Terminals are provided for either direct-coupled or a-c inputs. The input terminal cluster, at lower left of each section employs three universal binding posts of a type which will accept wire, pin or banana plug. The bottom post of the trio is low-side common and used for either type of input. High-side connection to the right upper black terminal will couple directly into the section; such connection to the left upper red terminal will feed the signal through a blocking capacitor, eliminating the d-c component. Standard 3/4 inch spacing of the posts permits use of either shielded or unshielded banana patch plugs.

(2) An individual pair of output terminals will be found at the lower right side of each section. Here again the lower post is common to system low-side and the upper black post is output high-side. The output terminals are always connected directly with the section output amplifier.

(3) Output d-c offset can be zeroed by means of separate, panel located, controls above the output terminals of the section. The upper small black knob is effective with the section in high-pass mode, while the lower knob controls the offset in the low-pass condition. Both fine and coarse controls are available for low-pass offset; the coarse control is screw driver accessible through a hole drilled in the center of the lower knob.

(4) Selection of high-pass or low-pass mode of operation is the function of the two-position rotary switch found above the section input terminals; turn clockwise for high-pass and counterclockwise for low-pass.

(5) Setting of cut-off frequency is the function of two controls. A multiplier rotary switch, located at the lower center of the section, is marked in powers of ten. The large dial at section upper center is calibrated over one decade with overlap. The product of the multiplier and dial settings is the section operating cut-off frequency in cycles per second.

3-4. Filter termination. Unlike passive filters, terminating impedance conditions

are determined for source and load in the case of ANALOG Filters*, i.e. filter response shape is not related to the impedance presented by source and load, due to isolation made possible by the active elements employed. Thus the LH-42 input impedance, composed of a few picofarads of capacitance shunting a resistance of several megohms, can be considered as a bridging load across most sources. Where the input source requires a particular terminating impedance, this may be provided by shunting the section input terminals with a resistor equal to the nominal value of the desired impedance. Somewhat different considerations pertain to the load end of the filter. Here the load sees a virtual impedance presented by the section output amplifier, a device employing feedback for the usual objectives of maximizing stability and minimizing distortion. Open circuited, this amplifier can handle an excursion of approximately 65 volts peak-to-peak. Short circuited output current swing is limited to about 20 ma peak-to-peak. The volt-ampere capabilities into the load is a function bounded by these extremes. Thus the permissible peak output signal will be reduced when working into low load impedance. If this load is a pure resistance, very nearly open circuit clipping level will prevail down to about 3,000 ohms with limiting level varying in proportion to load resistance for lower values of the latter. Loads below 300 ohms resistive may incur production of unacceptable distortion. Checks should be made in any event of proposed load conditions to determine actual results to be expected.

3-5. Modes of operation. Besides separate channel use of the individual sections of the Type LH-42D ANALOG Filter* in high-pass or low-pass mode, several other operational modes are possible, applying both sections to a single signal channel. These include BAND-PASS, BAND-REJECT, BAND-REJECT WITH NULL or double cut-off as high-pass or low-pass device. Depending upon the mode desired these involve either cascading or paralleling the sections electrically.

(1) For BAND-PASS operation, connect output high-side terminal of left filter section to high-side d-c input terminal of right section. (NOTE: low-side terminals are common, hence no external connection is required.) Turn left section mode control to HIGH-PASS, and right section mode control to LOW-PASS. Connect signal source left section input terminals and load to right section output. Select desired frequency pass band using left section tuning controls to set low end cut-off and right section tuning controls for high end cut-off.

(2) For double rate HIGH-PASS or LOW-PASS operation, connect as in 1 setting both mode controls in the same position. Set frequency controls to the same setting at the desired cutoff frequency. (NOTE: it is possible to control pass band shape to some extent by staggering the dial settings.)

(3) To achieve BAND-REJECT operation the two sections should be paralleled at their inputs to the signal source. Due to mutual loading effects it is not practicable to parallel the outputs directly. Two equal valued resistors may be connected to the respective output terminals and their free ends joined to form a load terminal. This mode will entail a 6db signal level minimum loss. The actual resistor value used should be as high as possible consistent with the impedance of the load, hence this mode is best effected into a load circuit intrinsically bridging. Set one filter section in low-

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pass mode, the other in high-pass mode. The rejection band will be determined by the respective cutoff settings. Shift reaches 180° at about 63% of the low-pass cutoff frequency and 159% of the high-pass setting. These shifts are of opposite sign, hence it is possible to achieve a rejection null using appropriate dial tuning for phase control and the mixing potentiometer for amplitude balance.

3-6. Specialized applications are possible which take advantage of the d-c coupling available in low pass mode. Here the filter may be used as an averaging device with with an adjustable time base, for extracting a relatively slowly varying quantity from a signal. Clamping of certain waveforms before application to the filter set in direct coupled low pass mode permits their demodulation. For example, pulse amplitude or pulse width modulation may be extracted by this process. Care should be taken to avoid filter overload on pulse peaks, however, which might cause severe distortion of the extracted signal.

SECTION IV

Description

4-1. Spectrum Instruments Type LH-42 ANALOG Filter* is a continuously tunable, active network device with complementary characteristics as a high-pass or a low-pass filter. The response in either mode of operation is 7-pole Butterworth both in amplitude and phase. Unlike its passive prototype counterpart, the ANALOG Filter* is a unilateral device with complete isolation of both signal source and load from the response determining elements. The amplitude response is nominally flat in the pass-band, within a specified tolerance and essentially constant in attenuation slope at 42 decibels per octave in the stop band. The nominal 3 decibel attenuation point, relative to the pass band, defines the cutoff frequency. When operating as a low-pass filter, response is flat to d-c or zero frequency. As a high-pass filter, the reponse extends upward from the cutoff frequency setting and is controlled to 2.5mc/sec. The output is usable, however, to approximately 5mc/sec.

4-2. The Butterworth characteristic is synthesized by a cascade of R-C time constant circuits of equal value with active elements interposed. The active element used in the LH-42 is a triode vacuum tube section in cathode follower configuration. Each of the eight cathode followers employed serves to approximate closely an ideal impedance changing device, the tube grid presenting insignificant loading to its driving point and the cathode output point appearing as a voltage behind a neglectable impedance to the load. Iterative feedback loops of precisely controlled gain complete the process by which the desired characteristic is generated. All critical components involved in the feedback configuration, as well as the load resistors of the several cathode followers are located in an encapsulated assembly or block, which serves as an environmental seal and thermal stabilizer. Circuit components comprising the tuning elements, i.e. the precision decade capacitors and dial tuned variable resistors gangs, are chosen for inherent stability.

4-3. Referring to the schematic; signal applied to the input terminals is applied to the grid of buffer stage VIA either directly, or through blocking capacitor C1, depending upon whether a-c or d-c input terminal is selected. Seven time constant circuits, each comprising a variable resistor deck Rv and a capacitor bank Ct, are identified by letter subscripts, a,b,c,d,e,f & g. Signal routing through these time constant pairs and the associated active buffers is controlled by a twelve pole, double throw switch bank operated by the mode selector knob on the panel. This switch bank also selects auxiliary functions appropriate to the operating mode such as gain tracking and d-c offset correction. Both the sense and position order in the signal path of the seven time constant circuits differs from high-pass to low-pass. For low-pass the resistive elements are in series with the signal path and the capacitors are in shunt, while the situation is reversed in high pass-mode. In some styles of the LH-42 series a gain tracking network, including a variable resistor driven by the tuning dial, is included. Other styles do not require this circuit. Gain trimming potentiometers are internally located and identified on a circuit board mounted to the rear of the mode switch and accessible with bottom cover removed. Additional controls are provided on this board which affect the filter shape factor. Following passage of the signal through the processing sections, it is applied to an output amplifier consisting of a pentode and one twin triode tube, thence to the output terminals.

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SECTION V

Maintenance

5-1. Calibration. Frequency calibration of the LH-42 ANALOG Filter* is dependent primarily upon the built-in values of the time constant determining components. These are carefully selected and stabilized during the manufacturing process and are not subject to change because of wear, since neither the capacitive nor the resistive components include rubbing surfaces. Selection of the range capacitance in decade steps is performed by switching, while the ganged rheostat employs a gold plated increment plate with mating gold plated shorting wiper in each section to vary the in-circuit portion of a multi-resistor chain in small finite steps. The number of steps is sufficiently great to permit resolution much finer that the calibration readability, hence effectively continuous tuning. Recalibration of these elements with proper tracking can only be accomplished by replacement of the entire tuner or range assembly which, in the rare event of necessity, is not recommended as a field service operation.

5-2. Proper coordination of high and low pass performance, as well as conformity with the Butterworth curve in both modes is a function of the several feedback loops previously referred to and, to a lesser extent, of tube condition, with respect to those serving as the active coupling elements. Every effort is made to preserve the fixed optimum gain in each loop by preadjustment and encapsulation of precision attenuators in the loops where required. Small external variations can be made in the attenuators of one loop by either potentiometer trimming controls or factory adjusted fixed resistors tailored to each case. The exact set-up varies with the filter style.

5-3. When it is determined that filter performance is out of tolerance, observation should permit an evaluation of the most probable cause. Hence, a drooping of response below the normal in the vicinity of cutoff after long service is most probably due to transconductance decay in one or more tubes. Variation of response shape with dial setting, particularly if accompanied by a shifting, filter produced, d-c output offset, is a good indication of tube failure due to grid leakage. An internal short or open circuit condition in a tube can lead to an abnormally large d-c offset, particularly in the low-pass mode. Any of the above anomalies occuring simultaneously in both sections of of a dual section LH-42D filter, should cast immediate suspicion that the trouble lies with the common power supply. In any event it is imperative to absolve tubes as possible cause before attacking the problem otherwise.

5-4. When replacing the type 5840 pentode, which is part of the section output amplifier, it may be necessary to rebalance this amplifier using the control provided. This control is a small insulated thumbwheel potentiometer located on the block terminal board at the top rear of the filter compartment. To adjust this balance properly it is necessary to have available a sine waveform generator capable of providing about 70 volts peak-to-peak into a bridging load at a frequency of about 500 cps. With the instrument thoroughly warmed up, turn the section to high-pass mode and set the cutoff to a value of about one fifth the input generator frequency, with a d-c voltmeter, preferably one having a zero-center scale of $\pm$ 1.5 volts, adjust the output offset for zero. Gradually apply the 500 cps signal until the d-c offset varies from zero, then bring it back by turning the internal control on the block. Remove the signal and readjust to zero using only the panel offset control. Repeat this procedure until a signal of about 65 volts peak-to-peak can be handled without offset shift.

5-5. When interpreting compliance with specifications, care should be taken to include the several tolerance factors simul-

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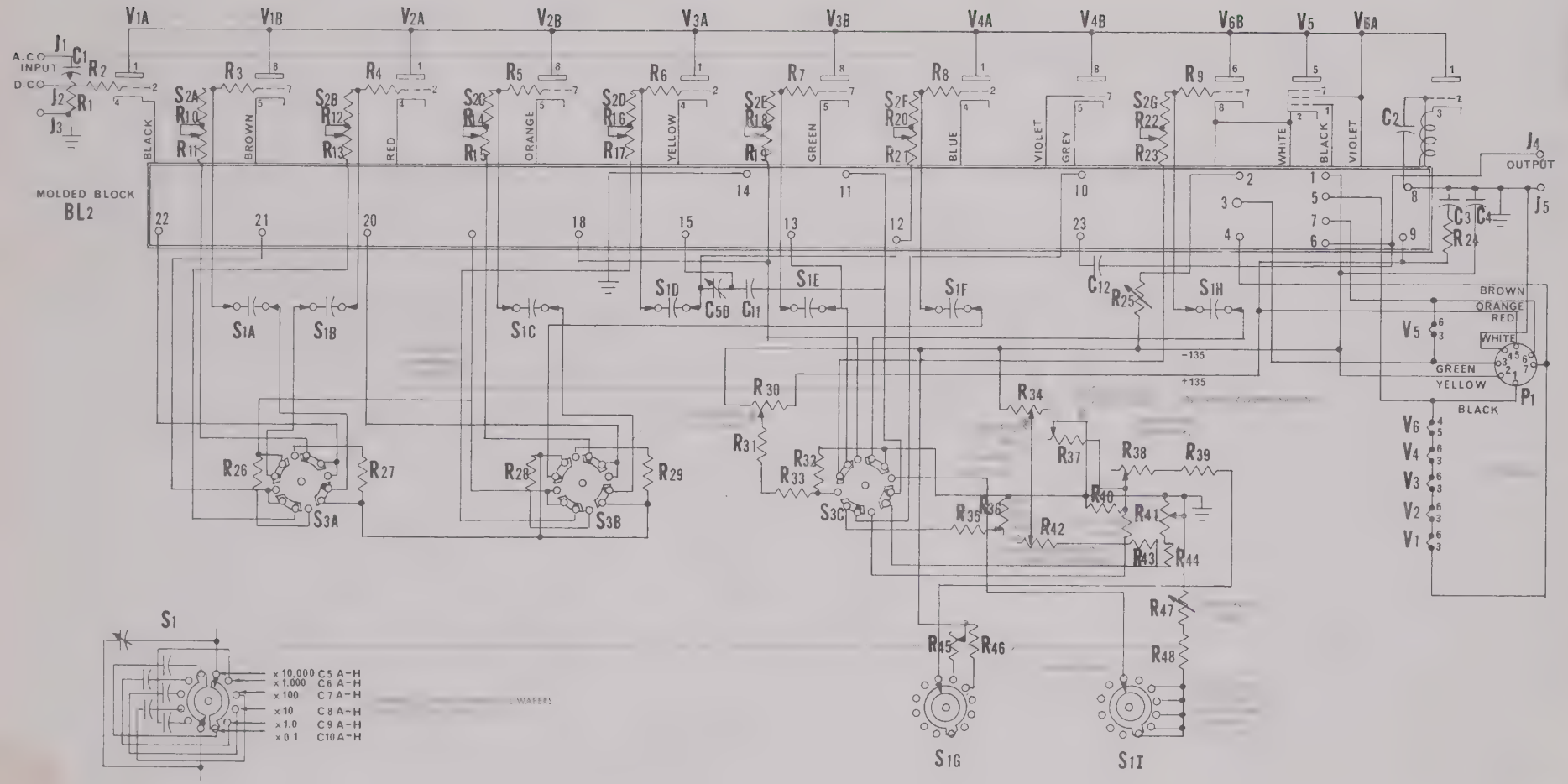
taneously. For example, the dial reading is considered to be within specified tolerance within the margin permitted relative to the pass band, due allowance being made for the spread in pass band gain allowed by the gain tolerance specification for the particular instrument in the particular range.

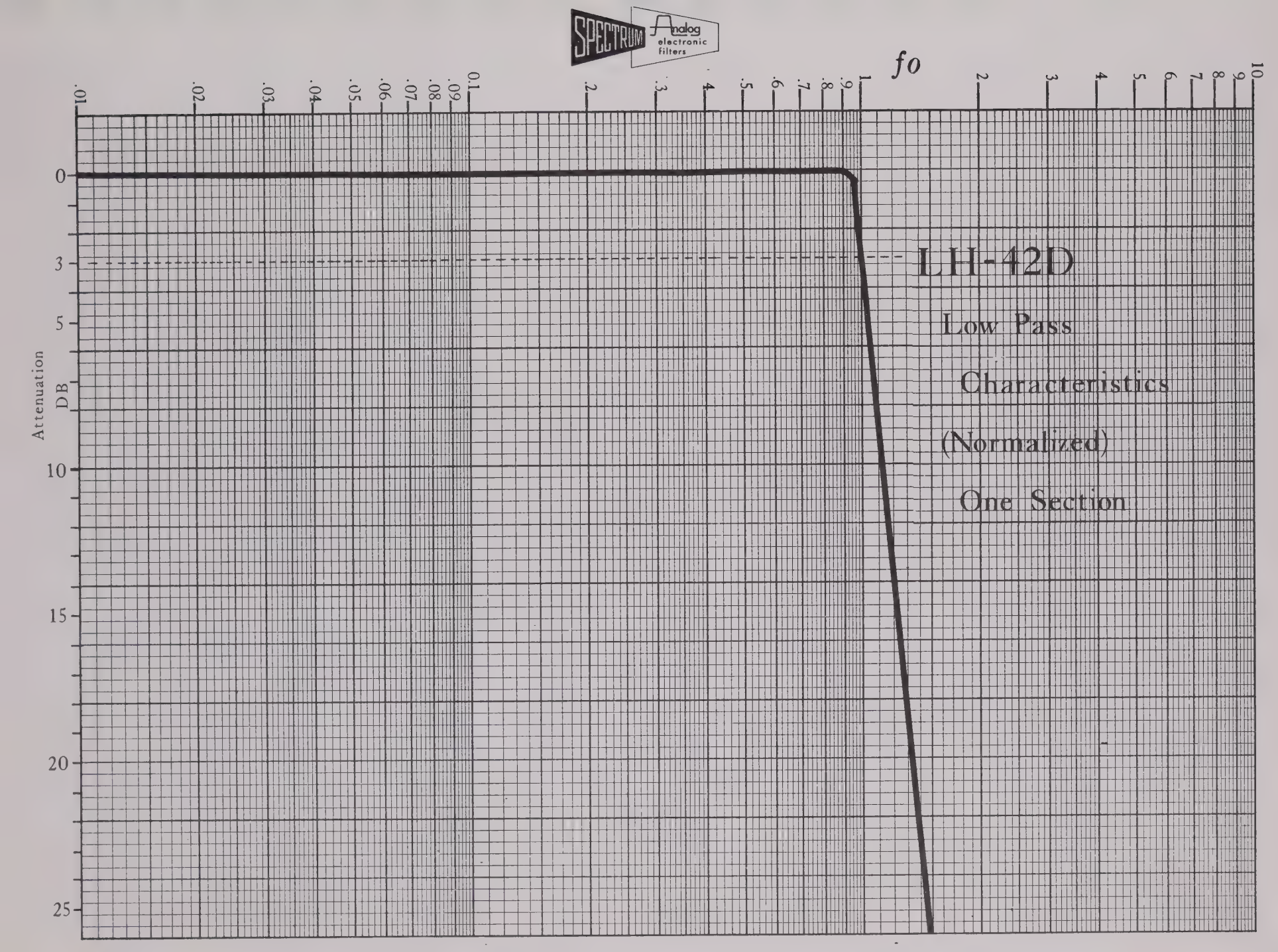
5-6. When the problem cannot be resolved by replacing faulty tubes, minor gain and shape factor adjustment, or correcting inadequate power supply performance (see power supply section) the manufacturer should be contacted for advice, giving all details possible, preferable in writing.

Parts List - LH-42 Unit Filter

REFERENCE DESIGNATOR	DESCRIPTION	MFR. PART NO.
BL-2	Assembly, Terminal Block	1690
C1	Capacitor, Mylar, 2.5ufd/400v	Gen. Instrument
C2	Capacitor, Ceramic, 7pf	Centralab
C3, C4	Capacitor, 0.1ufd/400wv	Radionic
C5 (a-h)	Capacitor, Trimmer, 6-30pf, x10,000	Centralab 827C
C6 (a-h)	Matched Capacitor Set, x1,000	2391
C7 (a-h)	Matched Capacitor Set, x100	2405
C8 (a-h)	Matched Capacitor Set, x10	2384
C9 (a-h)	Matched Capacitor Set, x1.0	2412
C10 (a-h)	Matched Capacitor Set, x0.1	2397
C11,	Capacitor, Mica, 68pf	Sangamo CM-15
C12	Capacitor, Molded, 1.5pf	Stackpole "gimmick"
J1-J5	Binding Post, Panel	Gen. Radio 938
P1	Connector Assembly, Power Supply	1271
R1	Resistor, Carbon, 5.6 megohm, 1/2 watt, 10%	AB Type EB or eq.
R2-R9, R24	Resistor, Carbon, 100 ohm, 1/2 watt, 10%	AB Type EB or eq.
R10-R23	Resistor, Factory Selected (part of tuner assembly S2)	
R25, R41	Resistor, Adjustable, 500K ohms	1470
R26-R29, R46	Resistor, Deposited Carbon, 1/2 watt, factory selected	
R30	Resistor, Variable, 100K ohm, 2 watts, 10%	AB Type J or eq.
R31	Resistor, 47K ohm, 1/2 watt, 10%	AB Type EB or eq.
R32	Resistor, Deposited Carbon, 1/2 watt, factory selected	
R33	Resistor, 15K ohm, 1/2 watt, 10%	AB Type EB or eq.
R34, R42	Potentiometer, Dual Concentric, 500/10,000 ohm	2268
R35	Resistor, Carbon, 12K ohm, 1/2 watt, 10%	AB Type EB or eq.
R36, R45	Resistor, Adjustable, 10K ohm, 1/2 watt	2500
R37	Resistor, Adjustable, 10K ohm, 2 watt, 10%	AB Type J or eq.
R38, R47	Resistor, Adjustable, 20K ohm, 1/2 watt	2477
R39	Resistor, Deposited Carbon, 12K ohm, 1/2 watt 5%	Kidco or eq.
R40	Resistor, Deposited Carbon, 6,800 ohm, 1/2 watt, 5%	Kidco or eq.
R43	Resistor, Carbon, 27K ohm, 1/2 watt, 10%	AB Type EB or eq.
R44	Resistor, 39K ohm, 1/2 watt, 10%	AB Type EB or eq.
R48	Resistor, Deposited Carbon, 16K ohm, 1/2 watt, 5%	Kidco or eq.
S1	Switch, Rotary, Selector	1367
S2	Tuner, Assembly, Interpolation	1134
S3	Switch, Rotary, Assembly	1252
V1-V4	Tube, Vacuum, Type 7963	Sylyania
V5	Tube, Vacuum, Type 5840	GE, Sylvania
V6	Tube, Vacuum, Type 7308	Amperex, Phillips or Telefunken

LH-42 UNIT FILTER




SPECTRUM
Analog
electronic
filters
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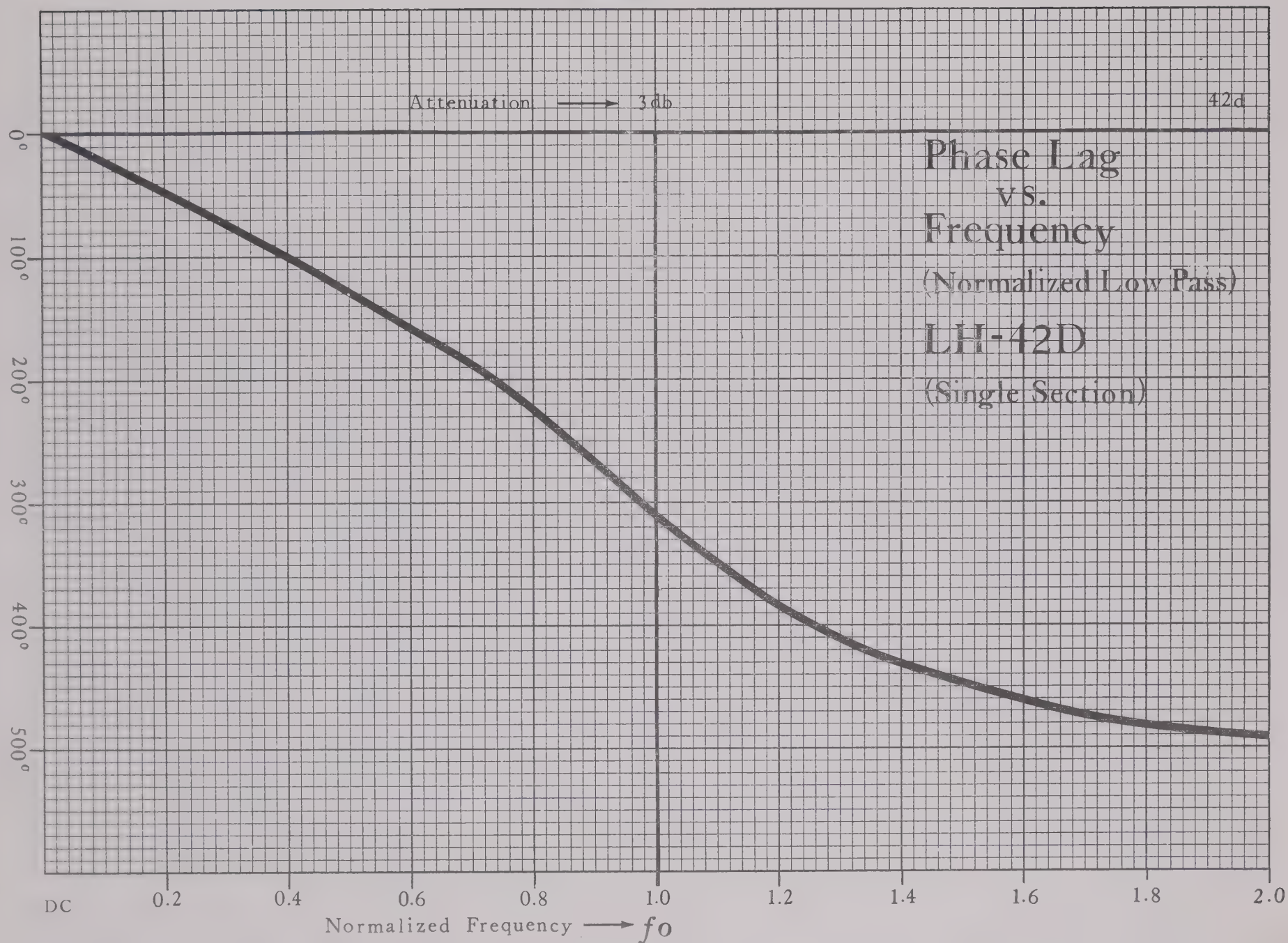
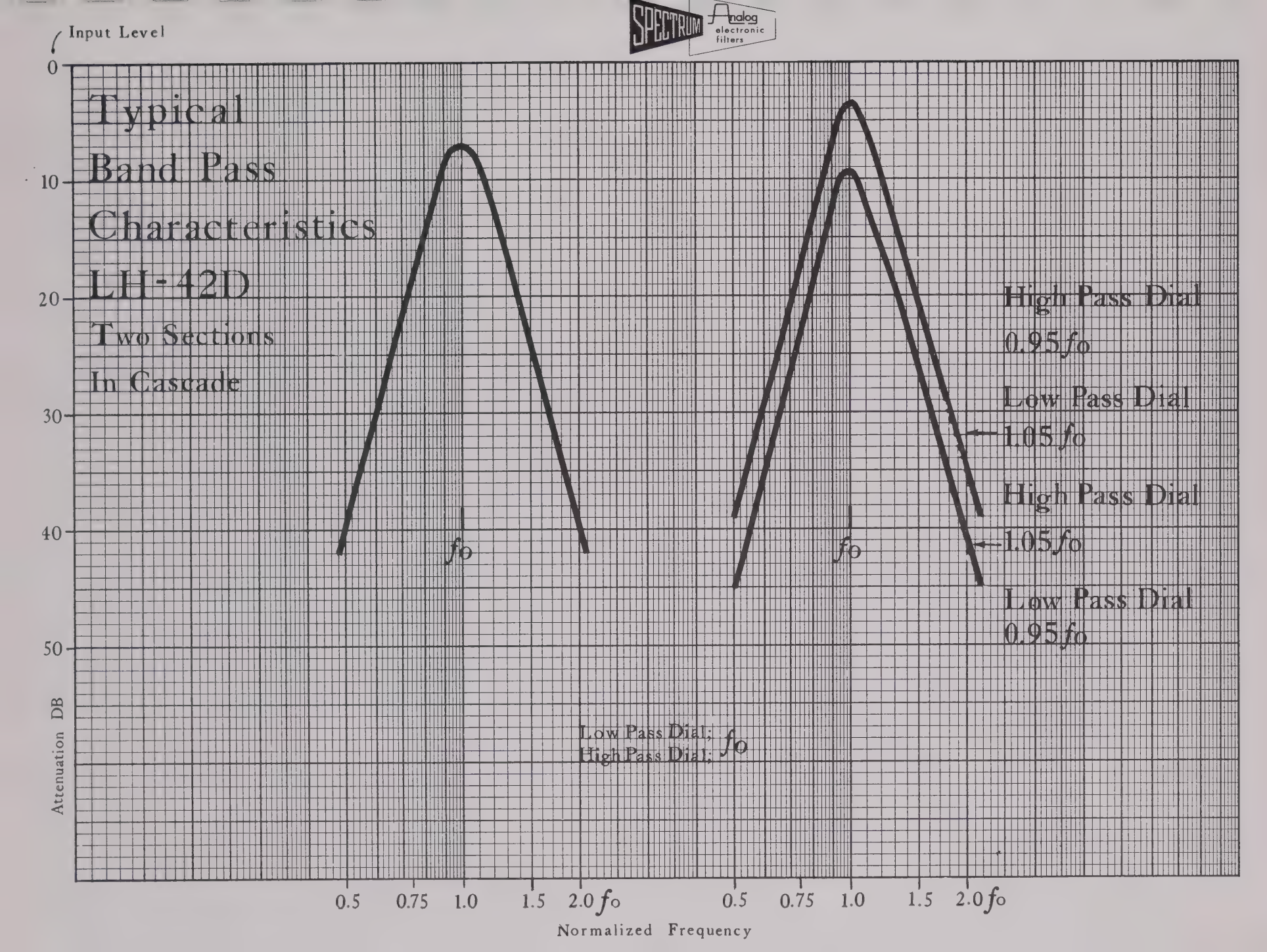
DB
LH-42D
Low Pass
Characteristics
(Normalized)
One Section

SPECTRUM Analog electronic filters




Input Level
0
10
20
30
40
50
Attenuation DB
Typical
Band Pass
Characteristics
LH-42D
Two Sections
In Cascade
SPECTRUM
Analog
electronic
filters
High Pass Dial
0.95 fo
Low Pass Dial
1.05 fo
High Pass Dial
1.05 fo
Low Pass Dial
0.95 fo
fo
fo
Low Pass Dial: fo
High Pass Dial: fo
0.5
0.75
1.0
1.5
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0.5
0.75
1.0
1.5
2.0 fo
Normalized Frequency

POWER SUPPLY PS-12
Circuit Description

Power Supply PS-12 is an all solid state unit furnishing a composite output of three tightly regulated and interrelated d.c. voltages. These are (a) a main output at 270 vdc, a subsidiary output of 135 vdc sharing a common negative terminal with the main output and (c) a third 37 vdc supply whose negative terminal is common with 135 supply positive terminal. Functionally, the 135 volt supply serves to center tap the 270 volt supply at a nominally grounded point, while the 37 volt supply powers vacuum tube heaters in a series string arrangement. The 135 volt supply is referenced to the output of the 270 volt regulator; the 37 volt supply is referred to its own zener diode.

The 37 volt heater supply is always connected to the load jacks. The center tapped system is routed through a normally open two pole relay controlled by a thermal time delay device. Heater warm-up is thus assured before main tube anode power is applied. The several regulators incorporate overload protection and are fused for sustained shorts.

Line power is applied through fuses F3 and F4 and switch S1. Power transformer T1, with a single primary and two secondaries, supplies all rectifiers. Closing of switch S1 also initiates cycling of time delay relay RL1, which is bridged across the transformer primary.

Three rectifier circuits are provided. All anode power is derived from the center-tapped secondary and the full wave system comprised of diodes D3x, D4x, D7x and D8x, choke L1 and filter capacitor C3y. An auxiliary full wave rectifier including diodes D1, D2, D5 and D6 and capacitors C1x, C2x constitutes a source of excitation current for the 270 volt regulator. THE TOTAL OF THESE SUPPLIES, WHICH ARE EFFECTIVELY IN SERIES, IS A VOLTAGE OF POTENTIALLY LETHAL PROPORTIONS, BACKED UP WITH SUFFICIENT CAPACITANCE TO CAUSE SEVERE INJURY IF TOUCHED. FOR THIS REASON THE EQUIPMENT SHOULD NEVER BE OPERATED WITH THE COVERS REMOVED, EXCEPT FOR SERVICING PROCEDURES CONDUCTED WITH DUE CARE.

Main (270 volt) Regulator. This output is controlled by pass transistor Q1z in the positive leg. Transistors Q5b and Q6b form a common emitter differential pair whose bases are fed respectively by reference diode D11y and resistive divider from the load side of the regulator. Amplifier error signal drives the Darlington connected chain consisting of Q3y, Q2z and the pass transistor, Q1z. Zener diode D9y, divider fed from the exciter supply, maintains a relatively constant collector source for transistors Q3y and Q5yb. Resistor R14y enhances regulation for line variations by applying a compensating sample to the base of Q5yb.

Q9z is the pass transistor for the 135 volt center tapping regulator. All pass current for this regulator is taken from regulated 270 v. through resistor R41z. Q11yc and Q12yc in combination serve as the differential amplifier. The reference in this case is supplied by emitter follower Q10yc as a divider-sampled fraction of the main supply. Pass transistor Q9z is driven by amplified error signal from the collector of Q12yc, whose base is connected to output sampling divider R39y, R40y.

The rectifier circuit for the 37 volt supply consists of bridge D15w, D16w, D17w, and D18w, and filter capacitors C8w, C9w. This supply is driven from an independent secondary winding on the power transformer and contains its own reference diode, D19w. Sampled output from divider R30w, R31w is applied to comparator-amplifier transistor, Q7w, whose collector drives the pass transistor Q8w. R28w,

R29w supplies Q8w base current derived from the 270 volt output.

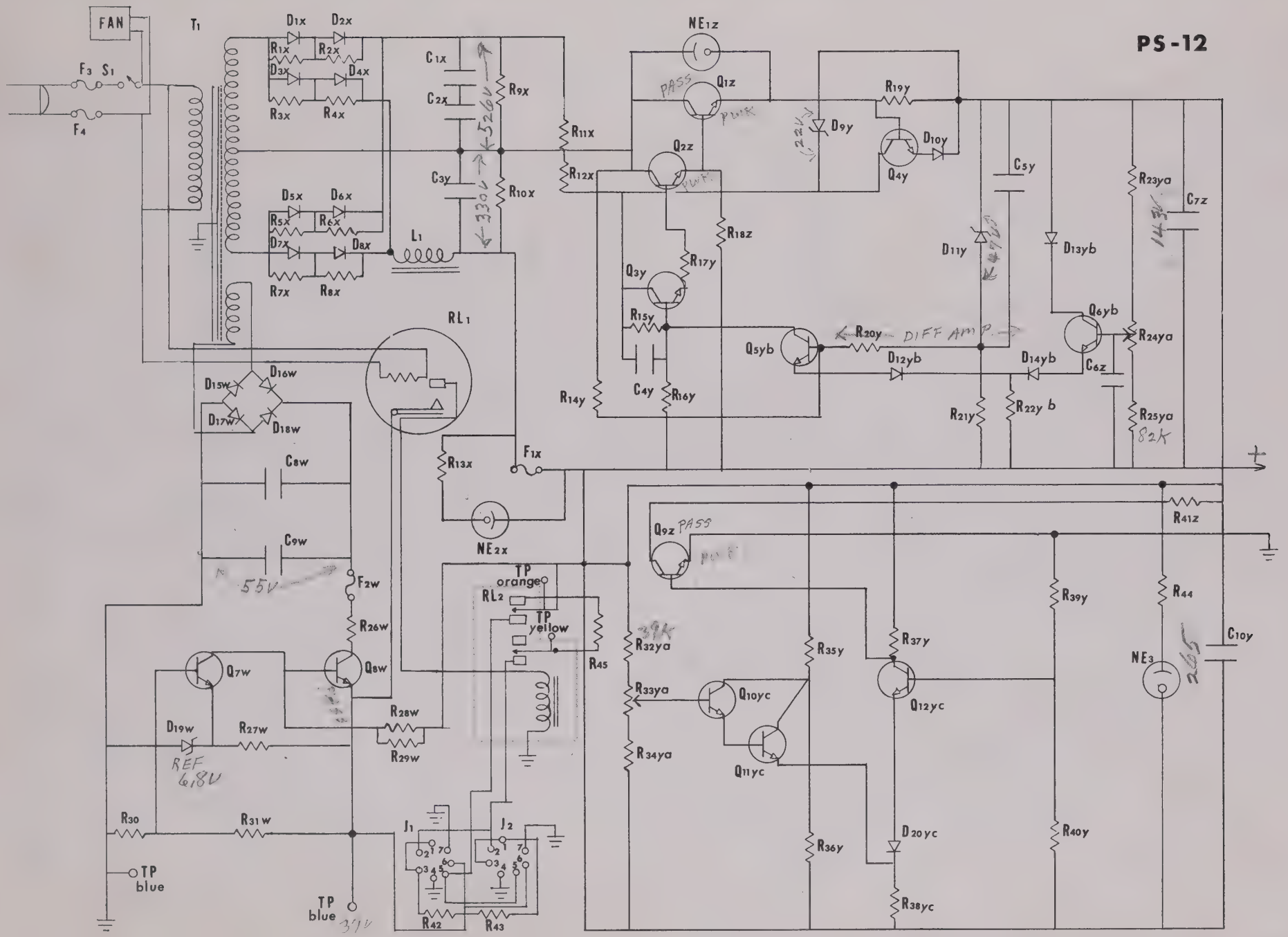
Each of the regulators described includes built-in protection features for overload conditions. In the 270 volt case, transistor Q4y normally draws no collector current. At a predetermined current overload, the drop in resistor R19y, which carries the full load current, will exceed the voltage necessary to overcome the combined barrier voltage of Q4y emitter junction and that of diode D10y, driving Q4y into conduction. Q4y loading siphons off further base drive to the pass complex and limits the load current to a safe value. Heavy short circuit conditions cause current limiting and, in consequence, excessive and destructive pass transistor drop, except for the presence of gas regulator tube NE1z. This normally inoperative circuit component will fire at a voltage drop considerably below Q1z permissible collector rating; sustained current through this bypass will blow fuse, F1x and shut down the supply. The circumstance of relatively low load current and large available supply voltage permits protection of the 135 volt source by resistor R41z. Normal load conditions leave sufficient collector potential on Q9z for regulation purposes. A predetermined excess load will cause R41z to assume the major portion of the supply drop and prevent damage to the transistors. Diode D20yc, a high voltage rectifier type, will block, protecting Q11yc. The 37 volt supply employs a pass transistor whose collector voltage rating is far in excess of the available supply voltage from the bridge rectifier. Output current is inherently limited to a value below the surge rating by resistor R26w. Steady state load current is limited by available base current passed by resistors R28w, R29w. Sustained short circuit conditions will blow fuse F2w. PROTECTIVE FUSES, F1x and F2w MUST NEVER BE REPLACED WITH FUSES OF GREATER RATING.

Power supply adjustments are limited to trimming potentiometers for the 270 and 135 volt supplies allowing a small range of correction. The 37 volt supply is determined by factory preset resistors in the sampling divider. Color-coded test points are available under the top cover on a sub-panel. These are respectively (1) BLACK for center tap (ground), (2) BLUE for plus 37 volts, (3) ORANGE for the positive end of the 270 volt regulator and (4) YELLOW for common high voltage negative. Because of the previously described configuration employed, voltage checks should be referred to the common negative to avoid confusion.

Mechanically, the components of the regulator package, aside from the power transformer, filter choke, main filter capacitor, the relays and the test points are mounted on four plug-in circuit cards retained by the power supply rear cover. These boards are identified by the letters "W", "X", "Y", and "Z", corresponding to the letter subscripts noted on the diagram and circuit description. Components not bearing these locating subscripts are not mounted on circuit boards.

The power supply may be operated with the "W" board removed. DO NOT UNDER ANY CIRCUMSTANCES APPLY POWER WITH ANY OTHER BOARD OUT OF CIRCUIT. Such action may cause severe damage to the remaining boards. Voltage trimming adjustment should be performed in a cut-and-try manner on a "Y" board removed from circuit, replacing the board and checking between tries. Replace the plastic cover enclosing the potentiometers before returning the unit to service.

6332
PHILCO
260-6035
30932


PS-12
FAN
T1
F3 S1
F4
D1x D2x
R1x R2x
D3x D4x
R3x R4x
C1x
C2x
C3y
R9x
526V
330V
R10x
R11x
R12x
D5x D6x
R5x R6x
D7x D8x
R7x R8x
L1
RL1
NE1z
Q1z
PASS
Q2z
PWR
R19y
D9y
D10y
Q4y
C5y
D11y
D13yb
R23ya
C7z
R18z
R17y
Q3y
R15y
Q5yb
R20y
DIFF AMP.
Q6yb
R24ya
C6z
D12yb
D14yb
R14y
C4y
R16y
R21y
R22y b
R25ya
82K
D15w D16w
D17w D18w
C8w
C9w
55V
R13x
F1x
NE2x
Q9z PASS
R41z
TP orange
RL2
TP yellow
R45
F2w
R26w
Q7w
Q8w
R28w
R29w
D19w
R27w
REF 6.8V
R32ya
R33ya
R34ya
Q10yc
Q11yc
R35y
R37y
Q12yc
R39y
R44
NE3
C10y
R30
R31w
J1
J2
TP blue
TP blue 37V
R42
R43
R36y
D20yc
R38yc
R40y

PARTS LIST - PS-12

REFERENCE DESIGNATOR	DESCRIPTION
C1x,C2x	Capacitor, electrolytic, tubular, 20ufd/350w.v.
C3y	Capacitor, electrolytic, twist-lock, 320ufd/350w.v.
C4y, C5y	Capacitor, Mylar, 0.1ufd/400v.
C6z	Capacitor, Mylar, tubular, 2.5ufd/200v.
C7z	Capacitor, electrolytic, tubular, 20ufd/350w.v.
C8w, C9w	Capacitor, electrolytic, tubular, 250ufd/64w.v.
C10y	Capacitor, electrolytic, tubular, 20ufd/350w.v.
D1x-D8x	Diode, silicon, 0.5a/400p.i.v, Erie 3004
D9y	Diode, zener, type 1N4748
D10y	Diode, silicon, 0.5a/400p.i.v., Erie 3004
D11y	Diode, zener, type 1N4756
D12yb-D14yb	Diode, silicon, 0.5a/400p.i.v., Erie 3004
D15w-D18w	Diode, silicon, 0.5a/400p.i.v., Erie 3004
D19w	Diode, zener, type 1N4736
D20yc	Diode, silicon, 0.5a/400p.i.v., Erie 3004
F1x, F2w	Fuse, type 3AG, 1 amp.
F3, F4	Fuse,line, type 3AG, 3 amp.
J1, J2	Socket, tube, miniature 7 pin
L1	Choke, Filter, 1.2h
NE1z	Tube, regulator, type OB2
NE2x	Lamp, neon, type NE2
NE3	Lamp, pilot, neon, type NE51
Q1z	Transistor, type 2N3583
Q2z	Transistor, RCA, type 40424
Q3y, Q4	Transistor, type 2N3568
Q5yb, Q6yb	Transistor, type 2N3568
Q7w	Transistor, type 2N3568
Q8w	Transistor, type 2N4347
Q9z	Transistor, RCA, type 40424
Q10yc-Q12yc	Transistor, type 2N3568
R1x-R8x	Resistor, carbon, 1 meg. ohm, 1/2 watt ±10%
R9x	Resistor, carbon, 680K, 1/2 watt, ±10%
R10x	Resistor, carbon, 1.5 meg. ohm, 1/2 watt, ±10%
R11x, R12x	Resistor, carbon, 27K ohm, 2 watt, ±10%

REFERENCE DESIGNATOR	DESCRIPTION
R13x	Resistor, carbon, 1 meg. ohm, 1/2 watt ±10%
R14y	Resistor, carbon, 5.6 meg. ohm, 1/2 watt, ±10%
R15y	Resistor, deposited carbon, 20K ohm, 1/2 watt, ±5%
R16y	Resistor, carbon, 470K ohm, 1/2 watt, ±10%
R17y	Resistor, deposited carbon, 3K ohm, 1/2 watt, ±5%
R18z	Resistor, deposited carbon, 100K ohm, 1/2 watt, ±5%
R19y	Resistor, carbon, 2.7 ohm, 1 watt, ±10%
R20y	Resistor, carbon, 100 ohm, 1/2 watt, ±10%
R21y	Resistor, carbon, 27K ohm, 2 watt, ±10%
R22yb	Resistor, carbon, 110K ohm, 1 watt, ±10%
R23ya	Resistor, deposited carbon, 15K, 1/2 watt, ±10%
R24ya	Resistor, variable, 4.7K, 1/2 watt
R25ya	Resistor, deposited carbon, 82K ohm, 1/2 watt, ±5%
R26w	Resistor, wire wound, 4.7 ohm, 7 watt, ±10%
R27w	Resistor, deposited carbon, 3.9K ohm, 1/2 watt, ±5%
R28w, R29w	Resistor, wire wound, 15K ohm, 5 watt, ±10%
R30w	Resistor, deposited carbon, 680 ohm, 1/4 watt, ±5%
R31w	Resistor, deposited carbon, 2.7K ohm, 1/2 watt, ±5%
R32ya	Resistor, deposited carbon, 39K ohm, 1/2 watt, ±5%
R33ya	Resistor, variable, 4.7K ohm, 1/2 watt
R34ya	Resistor, deposited carbon, 27K ohm, 1/2 watt, ±5%
R35y	Resistor, deposited carbon, 36K ohm, 1/2 watt, ±5%
R36y	Resistor, deposited carbon, 47K ohm, 1/2 watt, ±5%
R37y	Resistor, deposited carbon, 43K ohm, 1 watt, ±5%
R38yc	Resistor, deposited carbon, 27K ohm, 1 watt, ±5%
R39y	Resistor, wire wound, 820 ohm, 10 watt, ±10%
R40y, R45	Resistor, wire wound, 4K ohm, 10 watt, ±10%
R41z	Resistor, wire wound, 2K ohm, 10 watt, ±10%
R42, R43	Resistor, wire wound, 36 ohm, 7 watt, ±10%
R44	Resistor, carbon, 820K, 1/2 watt, ±10%
RL1	Relay , time delay, Amperite, type 115N045T
RL2	Relay, double pole, single throw, normally open, Spectrum #1811
S1	Switch, toggle, power, Spectrum #2087
T1	Transformer, power, Spectrum #2447

WARRANTY

The products manufactured by Spectrum Instruments, Inc., are warranted against defects in material and workmanship for a period of one year following shipment to the customer. This warranty is limited to repair and replacement, if necessary, of such items, which following inspection at manufacturer's plant, prove to be defective. Manufacturer assumes no liability for consequential damages. Transportation and insurance charges are excluded from our liability. The above stated warranty is limited to products which have not been altered, abused or subjected to attempted repairs by others. Unauthorized returns will not be accepted from carrier. For return authorization or assistance in clearing difficulties contact manufacturer directly at the address below. Please supply full details of difficulty and include identification by instrument model and serial number.

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